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Bankruptcy Prediction Based on the Autonomy Ratio

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Abstract: The theory and practice of the financial ratio analysis suggest the existence of a negative correlation between the autonomy ratio and the bankruptcy risk. Previous studies conducted on a sample of companies from Timis County (largest county in Romania) confirm this hypothesis and recommend the autonomy ratio as a useful tool for measuring the bankruptcy risk two years in advance. The objective of the current research was to develop a methodology for measuring the bankruptcy risk that would be applicable for the companies from the Timis County (specific methodologies are considered necessary for each region). The target population consisted of all the companies from Timis County with annual sales of over 10,000 lei (aprox. 2,200 Euros). The research was performed over all the target population. The study has thus included 53,252 yearly financial statements from the period 2007 – 2010. The results of the study allow for the setting of benchmarks, as well as the configuration of a methodology of analysis. The proposed methodology cannot predict with perfect accuracy the state of the company, but it allows for a valuation of the risk level to which the company is subjected.

Keywords: ratio analysis; financial statements; risk; accuracy; benchmark

JEL classification: G33; M10

1. Introduction

In the context of the economic crisis, as well as that of the changes generated by the entrance of Romania in the European Union, the annual frequency of bankruptcy cases has increased at national level, reaching almost 3% by the end of 2013.

The increased frequency of the annual bankruptcy cases was accompanied by an increase in the loan default ratio, Romania topping in this regard at the end of 2012 the 4th place within the European Union and 6th place worldwide in a ranking which included 131 countries (Brîndescu-Olariu, 2014b).

The state of bankruptcy negatively affects all stakeholders, which makes the existence of instruments for bankruptcy prediction important. The general goals of companies are usually related to maximizing profits and shareholders' wealth (Ștefea & Circa, 2006). In order to reach such goals, capital must be invested. The investment decisions must be fundamented not only on predicted return ratios, but also on risk analyses. Assessment of the default risk in general and of the bankruptcy risk in particular has always been in the centre of the financial ratio analysis.

The financial ratio analysis has been used since the second half of the 19th century, being initially meant as an instrument for evaluating the payment capacity of companies demanding for bank loans. The utility

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of financial ratios has been in debate for over 100 years worldwide, with no success in developing a generally accepted theory of the financial ratios.

In practice, the analyses are mostly focused on the calculation of the ratios. Some of the practical guides offer synthetic suggestions for the interpretation of the ratios. For some ratios, there are benchmarks, although the benchmarks are usually not statistically determined.

In other cases, the financial analyst is indicated to compare the values of the ratios with mean values from the same economic field. Such an approach remains poor in terms of content, in the absence of statistics regarding the number and performance of the companies with ratios over or below the mean.

Furthermore, there is a tendency to confuse the mean level with the optimum level. As in the Romanian economy over half of the companies that submit their financial statements to the fiscal authorities report losses, references to the mean cannot be an option that stimulates performance.

Under these circumstances, most of the financial analysis performed in practice restrain to superficial descriptions of the balance sheets of the companies, not reflecting more than simple accounting interpretations.

The basis of all theories regarding the financial ratios is that the ratios contain coded messages regarding the state of the company. In this perspective, the methodology of analysis must offer a decoding solution (a procedure for interpreting the ratios and concluding in regards to the state of the company).

Although financial ratio analysis has been in use for the last 150 years, the researches in this field have failed to isolate with clarity the capacity of each ratio to describe the state of the company from a specific point of view. Under these circumstances, not only there is no generally accepted decoding methodology, but there is no definite proof of useful content for each ratio.

Over its 150 years of existence, the applicability of the financial ratio analysis has always been questioned. In moments where the credibility of the financial ratio analysis had reached minimum levels, the researchers managed to prove again its utility by going back to its initial objective: evaluating the payment capacity of the company, or the risk of failure to pay its debts. As the notion of "failure" is general and thus difficult to quantify, the studies generally targeted a specific type of failure: bankruptcy.

Studies that remained as references in the history of the financial ratio analysis reconfirmed its utility by proving the existence of significant correlations between the values of the financial ratios and the probability of bankruptcy.

Initially, the approaches were univariate. Some of the most important contributions in this field include (Yadav, 1986):

- the study conducted by J.R. Ramster and L.O. Foster in 1931 over a sample of 173 companies;
- the study conducted by Fitz Patrick in 1932 over a sample of 38 de companies, of which 19 were bankrupt and 19 were healthy;
- the study conducted by Raymond Smith and Winakor Arthur in 1935 over a sample of 183 companies that failed over the period 1923-1931;
- the study conducted by Charles Merwin in 1942, over a sample of 900 companies.

Inspired by the models developed by Altman (1968) through discriminant analysis and later on by Ohlson (1980), through logistic regression, multivariate studies in the field of bankruptcy prediction have been performed all over the world during the last 50 years (some of the more recent studies are presented in table 1).

Table 1. Bankruptcy prediction studies

No.	Country	Sample	Main author	Year
1	USA	1,249	Hatem Ben-Ameur	2008
2	China	unspecified	Wang Ying	2010
3	USA	468	EMEL KAHYA	1999
4	Turkey	54	Mine Ugurlu	2006
5	Italy	40,574	Giovanni Butera	2006
6	Pakistan	52	Abbas Qaiser	2011
7	Canada	633	S. Ben Amor	2009
8	USA	2,128	Gregory Kane	1998
9	India	70	A.V.N. Murty	2004
10	Taiwan	54	Tsung-Kang Chen	2011
11	Singapore	34	Zulkarnain Muhamad Sori	2009
12	USA	14,303	Stephen A. Hillegeist	2003
13	Norway	98,421	Daniel Berg	2005
14	Tunisia	60	Mondher Kouki	2011
15	Japan	3,586	Ming Xu	2009
16	Great Britain	7,833	Dionysia Dionysiou	2008
17	USA	16,816	Sudheer Chava	2004
18	Croatia	156	Ivica Pervan	2011
19	France	190	Conan - Holder	1979
20	Tunisia	120	Hamadi MATOUSSI	1999
21	Greece	58	THEOHARRY GRAMMATIKOS	1984
22	Belgium	306	N. DEWAELHEYNS	2004
23	SUA	1.203	Mary Hilston Keener	2013
24	Russia	120	Elena Makeeva	2013
25	Poland	13,288	Kamil Fijorek	2012
26	Belarus	unspecified	Chernovalov, A.	2004
27	Albania	unspecified	Shkurti Rezarta	2010
28	Brazil	12	Matias Alberto Borges	2011
29	Serbia	232	Nemanja Stanišić	2013

No.	Country	Sample	Main author	Year
30	Hungary	154	Ottó Hajdu	2001
31	Czech Republic	757	Petr Jakubík	2008
32	Slovenia	19,627	Dusan Mramor	2003
33	Slovenia	29,698	Arjana Brezigar-Masten	2012
34	Sweden	3,982	Darush Yazdanfar	2008
35	Sweden	4,496	Darush Yazdanfar	2011
36	Europe	25,722	Kevin Keasey	2013
37	Finland	2,243	Laura Kainulainen	2011
38	Portugal	2,288	M. F. Santos	2006
39	Lithuania	230	O. Purvinis	2008
40	Estonia	16,443	Martin Grünberg	2014

Of the 40 papers from table 1 (Brîndescu-Olariu, 2016), 17 used paired samples and 12 only included listed companies. All the 40 studies were multivariate.

In Romania, at the beginning of the 1990s, the theory and practice of financial ratio analysis borrowed popular ratios and models from the international literature, with no adaptation to the specifics of Romanian companies (the Altman model from 1968, the Conan-Holder model, the Central Bank of France model).

Over the last 20 years several national models for the prediction of bankruptcy were developed. Still, the majority of these models were affected by deficiencies in terms of statistical methodology or by the use of isolated samples that did not allow for applicability over all Romanian companies:

- 1996: Mânecuță and Nicolae model (Bordeianu et. al., 2011);
- 1998: Băileșteanu model (Băileșteanu, 1998);
- 1998: Ivoniciu model (Bordeianu et. al., 2011) ;
- 2002: Lorant-Eros Stark model;
- 2002: Anghel model (Anghel, 2002);
- 2010: Cârciumaru model (Cârciumaru, 2010);
- 2010: Căprariu model (Căprariu, 2010);
- 2010: Caracota, Dumitru and Dinu model (Caracota, Dumitru & Dinu, 2010) ;
- 2011: Bătrâncea model (Bătrâncea, 2011);
- 2012: Armeanu model (Armeanu et.al., 2012);
- 2012: Vintilă and Toroapă model (Vintilă & Toroapă, 2012);
- 2012: Mironiuc M., Robu M. and Robu I. Model (Mironiuc, Robu & Robu, 2012);
- 2013: Andreica model (Andreica, 2013).

The financial ratios, as well as the models borrowed from the foreign literature, are still employed today in the Romanian practice and still persist in the Romanian literature in the original form, although the Romanian accounting system (which was never similar to the systems of origins of the ratios and models) has changed in several stages.

The univariate financial ratios analysis methodologies were in most cases never statistically founded even for the populations of origin (most ratios were developed in USA, UK or France).

In Romania, the financial analysis currently represents an important instrument for most of the stakeholders of the company (creditors, managers, shareholders, investors, employees, auditors or external consultants).

Under these circumstances, there is an important need for the development of methodologies specific to the current characteristics of the Romanian companies. The current study is focused on the configuration of a methodology for corporate bankruptcy prediction based on the autonomy ratio, 2 years prior to the possible event. Based on the presumption that there are significant differences between the companies from different regions of Romania, the study only has in view the companies from the Timis County (largest county in Romania). In order to avoid the lack of representativeness of previous Romanian studies, the research was focused on a smaller geographical area. Instead, the research was not performed over a sample, but over the entire target population.

An important hypothesis circulated in the theory and practice of bankruptcy risk analysis is that the overuse of leverage is one of the main causes of bankruptcy. The overuse of leverage involves low autonomy ratios, which would sustain the hypothesis of a negative correlation between the autonomy ratio and the probability of bankruptcy.

Previous studies (Brîndescu-Olariu, 2015) conducted over companies from the Timis County confirmed the existence of a negative correlation between the autonomy ratio and the probability of bankruptcy within a 2-year span, as well as the statistical utility of the autonomy ratio for the valuation of the bankruptcy risk.

Developing a methodology for the assessment of the bankruptcy risk based on the autonomy ratio involves the establishment of benchmarks under which the company can be expected to go bankrupt (with certainty, or, at least with a specified probability).

Currently, different benchmarks for the autonomy ratio are being recommended in the theory and practice of the financial ratio analysis at national level:

- 33% - reorganization plans, Lala Popa and Miculeac (2009), Bistriceanu, Adochiței and Negrea (2001), Buglea and Stark (2003);
- 50% - BRD-GSG (Bătrâncea, 2006), Toma and Chivulescu (1994);
- 66,7% - Mihai, Buglea and Ștefea (1999);
- 70% - Bancpost (Bătrâncea, 2006).

These benchmarks are not grounded in the current national economic realities. Moreover, in most cases, the perspective of the analysis is not specified. It is usually expected that the autonomy ratio would show

levels of over a certain benchmark without clarifying the point of view from which such a situation would be considered as optimum.

The current research targets to set benchmarks for the autonomy ratio in correspondence with the present characteristics of the companies from the Timis County, as well as to develop a methodology for the assessment of the bankruptcy risk based on the autonomy ratio (a methodology that would be applicable to the studied population).

A study (Brîndescu-Olariu, 2015) conducted over a sample of 588 pairs of companies from the Timis County showed an accuracy of 62.8% in the classification of the companies as bankrupt or non-bankrupt based on the values of their autonomy ratios 2 years prior to the event. The benchmark established for the autonomy ratio at the level of the paired sample was of 10%. The study proved the usefulness of the autonomy ratio for the assessment of the bankruptcy risk, but it was not able to set a benchmark applicable to the entire population, because of the difference between the structure of the paired sample and the structure of the population (the frequency of bankrupt companies was of 50% within the paired sample, while under 3% within the entire population).

2. Population and Methodology

The population initially subjected to the analysis included all the companies from the Timis County that submitted financial statements to the fiscal authorities in the period 2001 – 2011 (247,037 yearly financial statements).

Financial ratio analysis was not considered applicable for companies with no yearly income, as the continuity of the operating activity represents a fundamental hypothesis of the financial ratio analysis.

Three phenomena with national impact were also considered for their potential of changing the profile of the companies that declare bankruptcy:

- The changes brought to the laws concerning bankruptcy through the adoption of law 85/2006;
- The entrance within the European Union in 2007;
- The manifestation of the economic crisis starting with the last quarter of 2008.

Under these circumstances, it was concluded that the initial population shows important problems of homogeneity, which do not recommend a unitary treatment:

- The companies with no activity cannot be evaluated based on the same methodology as the companies with a financial history;
- The companies that became bankrupt after the issue of law 2006/2006 show different characteristics compared to the companies that went bankrupt before 2007, under different laws;
- The cases of bankruptcy registered after 2009 have different causes compared to the cases appeared before the beginning of the economic crisis.

Taking all the aforementioned differences into account, the initial population was adjusted:

- all the yearly financial statements that reported sales under 10000 lei were excluded;

- only financial statements from the period 2007 – 2010 were retained.

The research targeted the risk of bankruptcy after 2 years from the date of the financial statements taken as reference in the analysis. As the interest was focused on the phenomenon of bankruptcy during the crisis period, the first financial statements included in the study were from 2007.

The last year for which data concerning the status of the companies was available was 2012. Under these circumstances, the last financial statements included in the study were those from 2010. Financial statements from 2011 were available, but information concerning the status of the companies at the end of 2013 was not.

Holding all the above into account, the target population included all companies from Timis County that submitted yearly financial statements to the fiscal authorities during the period 2007-2010 and that registered yearly sales of at least 10000 lei (aprox. 2200 Euros).

In accordance, 53,252 financial statements from the period 2007-2010 were included in the analysis. The companies of which financial statements were included for one year were not necessarily included for the following periods. As the study did not target a dynamics analysis, the yearly financial statements can be regarded as individual subjects.

The source of the data was represented by the online publications of the Ministry of Public Finances of Romania. The Romanian literature presents different alternatives for calculating the equity in general and the autonomy ratio in particular. The current study employed a method for calculating the autonomy ratio that would make the proposed methodology of analysis accessible to all stakeholders.

The details concerning the financing sources of the company published by the Ministry of Public Finances of Romania include: total debt, unearned revenue, provisions and equity. The autonomy ratio was calculated as follows:

$$\text{Autonomy ratio} = \frac{\text{Equity} + \text{Provisions}}{\text{Total financing sources}} \times 100\%$$

Total financial sources always equal total assets.

The calculation methodology is simple and the data required is easily accessible by any stakeholder of the company.

As a first step of the research, the cut-off value resulted from a study made on a paired – sample (Brîndescu-Olariu, 2015) was tested over the entire target population. Considering the structure of the target population, the "by chance" accuracy in classifying the companies as bankrupt or non-bankrupt two years ahead would be of aprox. 94.5%. A ratio is considered a useful classifier if it allows for a general accuracy at least 25% higher than the "by chance" accuracy (Chung, Tan & Holdsworth, 2008).

The companies of the target population were classified as bankrupt if they showed autonomy ratio of less than 10% or as non-bankrupt, if they showed autonomy ratio of at least 10%. The general accuracy thus obtained in the classification was compared to the "by chance" general accuracy.

In a second step, as the general accuracy ensured by the autonomy ratio at a cut-off value of 10% was significantly lower than the "by chance" general accuracy, the ROC Curve for the relationship between

the autonomy ratio and the state of the company (bankrupt or non-bankrupt) was built based only on the financial statements of 2010.

The ROC Curve was generated with the use of IBM SPSS software. For the construction of the ROC Curve, a state variable was defined, that took the value of 0 for non-bankrupt companies and the value of 1 for companies that went bankrupt 2 years after the date of the financial statements of reference. The ROC Curve graphically reflects the relationship between the sensitivity and the specificity for all possible cut-off values (van Erkel, Pattynama, 1998).

By inspecting the coordinating points of the ROC Curve, the cut-off value for the autonomy ratio that ensures the equality between the sensitivity and the specificity was identified.

The sensitivity represents the accuracy in the classification of the bankrupt companies, while the specificity represents the accuracy in the classification of non-bankrupt companies. The general accuracy can be calculated as a weighted average between the sensitivity and the specificity.

The ROC Curve also allowed for the calculation of the "Area Under the Curve", one of the most viable solutions in the valuation of the performance of a classifier (Hanely, McNeil, 1982; Faraggi & Reiser, 2002).

The cut-off value determined over the population of 2010 was tested for the population of the period 2007 – 2009. As the performance was inconsistent, in a third step, the population was grouped on 10 intervals of the autonomy ratio. The first objective was to identify the intervals for which the bankruptcy frequency was higher than 50%. Should such intervals had been found, the proposed methodology could have suggested classifying any company with an autonomy ratio within these intervals as bankrupt. As such intervals were not found, the proposed methodology defined risk classes, in accordance with the bankruptcy frequency for each interval of the autonomy ratio. For each interval of the autonomy ratio, a risk index was calculated by comparing the bankruptcy frequency of the interval to the average bankruptcy frequency.

In a final step, for practical purposes, 3 bankruptcy risk classes were defined based on the values of the autonomy ratio.

3. Results

Using 10% as cut-off value at the level of all target population, the accuracy in the classification reduces because of the structural differences between the target population and the paired sample (the target population has a significantly higher frequency off non-bankrupt firms).

With a 10% cut-off value, the accuracy of the prediction would be of 49.5% for the target population of 2010, 53.7% for the target population of 2009, 53.7% for the target population of 2008 and 55.9% for the target population of 2007.

Within the target population of 2010, the bankruptcy frequency in 2012 was of 2.85%. Under these circumstances, by classifying all 15,071 companies as non-bankrupt would ensure an accuracy of 97.15%, without the use of any information concerning the individual state of the companies. The use

of the autonomy ratio specific to each company as an additional information within an analysis performed on the entire target population does not ensure an increase of the accuracy.

More specifically, the minimum value of the autonomy ratio for the 2010 target population was of -524856% and it belonged to a non-bankrupt company. Using this value as cut-off would involve the classification of all the companies as non-bankrupt, thus obtaining an accuracy of 97.15%. The use of any other cut-off value would reduce the accuracy of the classification.

In a second step, the ROC Curve for the relationship between the autonomy ratio and the state of the company (bankrupt or non-bankrupt) was built based only on the financial statements of 2010.

By inspecting the coordinating points of the ROC Curve, the cut-off value for the autonomy ratio that ensures the equality between the sensitivity and the specificity was identified as being -4.10%. The general accuracy obtained for the population of 2010 by employing a cut-off value of -4.10% was of only 59.9%, but remained relatively consistent for the period 2007-2009 (as shown in figure 1).

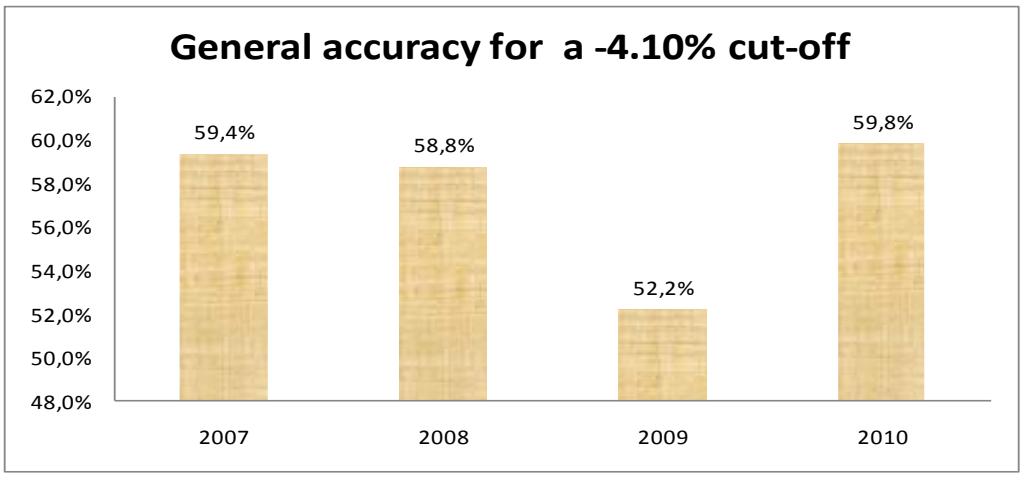

Figure 1. General accuracy for a -4.10 cut-off

The Area Under the Curve was of 0.649, showing a significant, but relatively weak classification capacity. Under these conditions, a more useful approach was considered to be the evaluation of the bankruptcy risk on intervals of the autonomy ratio. If the bankruptcy frequency specific to an interval would prove to be of over 50%, all companies with autonomy ratios within that interval could be classified as bankrupt. On a similar basis, companies with autonomy ratios within intervals where the bankruptcy frequency is lower than 50% could be classified as non-bankrupt.

By dividing the target population of 2010 on 10 intervals of the autonomy ratio, one may conclude that the bankruptcy frequency does not come close to 50% for none of these intervals (table 2).

Table 2. The bankruptcy frequency for the target population of 2010 on intervals

No.	Intervals of the Autonomy ratio	Total		Bankrupt		Non-bankrupt		% Bankruptcy
		15,071	100%	429	100%	14,642	100%	2.85%
1	Autonomy ratio < -20%	4,998	33.2%	209	48.7%	4,789	32.7%	4.18%
2	-20% <= Autonomy ratio < -10%	674	4.5%	29	6.8%	645	4.4%	4.30%
3	-10%<= Autonomy ratio < 0%	878	5.8%	36	8.4%	842	5.8%	4.10%
4	0%<= Autonomy ratio < 10%	1,293	8.6%	60	14.0%	1,233	8.4%	4.64%
5	10%<= Autonomy ratio < 20%	1,013	6.7%	21	4.9%	992	6.8%	2.07%
6	20%<= Autonomy ratio < 30%	805	5.3%	14	3.3%	791	5.4%	1.74%
7	30% <= Autonomy ratio < 40%	754	5.0%	20	4.7%	734	5.0%	2.65%
8	40% <= Autonomy ratio < 50%	706	4.7%	14	3.3%	692	4.7%	1.98%
9	50% <= Autonomy ratio < 60%	681	4.5%	6	1.4%	675	4.6%	0.88%
10	Autonomy ratio >= 60%	3,269	21.7%	20	4.7%	3,249	22.2%	0.61%

A tendency of reduction of the bankruptcy frequency can be noticed as the autonomy ratio increases, although it is not monotone.

The bankruptcy frequency doesn't reach the level of 5% for none of the 10 intervals. Consequently, the analyst that evaluates the bankruptcy risk associated to a specific company cannot take the decision of classifying it as bankrupt based exclusively on the value of its autonomy ratio. No matter the interval within which the autonomy ratio is positioned, the probability of not entering the bankruptcy state is higher than 0.95, which would suggest to the analyst to classify the company as non-bankrupt.

Under these circumstances, a possible solution could be to compare the bankruptcy probability of the companies form a specific interval (of the autonomy ratio) with the average probability of bankruptcy (for the entire target population). A risk index could be associated to every interval. Although a company could not be classified with 100% accuracy as bankrupt or non-bankrupt 2 years prior to the event, its risk of bankruptcy could be estimated based on the risk index specific to the interval of its autonomy ratio (table 3).

The current economic reality doesn't involve corporate bankruptcy risks of 0.5 at the level of the entire target population. A reality within which every year one in every two companies would go bankrupt would be characterized by chaos and would lead to full economic blockage.

Table 3. Risk indexes for the target population (2010), on intervals of the autonomy ratio

No.	Intervals of the autonomy ratio – target population of 2010	Risk index
1	Autonomy ratio < -20%	146.9%
2	-20% <= Autonomy ratio < -10%	151.2%
3	-10%<= Autonomy ratio < 0%	144.0%
4	0%<= Autonomy ratio < 10%	163.0%
5	10%<= Autonomy ratio < 20%	72.8%
6	20%<= Autonomy ratio < 30%	61.1%
7	30% <= Autonomy ratio < 40%	93.2%

8	40% <= Autonomy ratio < 50%	69.7%
9	50% <= Autonomy ratio < 60%	31.0%
10	Autonomy ratio >= 60%	21.5%

The yearly corporate bankruptcy frequency for the target population was of 0.24% - 2.85% during the period 2009 – 2012.

Under these circumstances, a stakeholder will not use as cut-off value the 0.5 probability of bankruptcy in his decision to collaborate with the company. Most probably, a creditor would avoid the collaboration with the company if the bankruptcy probability would be estimated at 0.2, or even 0.1.

Obviously, such a stakeholder would need a key for the estimation of the bankruptcy probability. Such a key should not be expected to classify each company as bankrupt or non-bankrupt by associating to each company a probability of bankruptcy higher or lower than 0.5. Considering the bankruptcy frequency at the level at the target population in 2010, the probability of bankruptcy can be estimated at 0.0285 for any company, without the use of any other key. Consequently, the autonomy ratio will be considered useful as a key for the prediction of corporate bankruptcy as long as it allows for the assignment to a company of a different bankruptcy probability than the average probability.

Table 3 presents risk indexes for each of the 10 intervals of the autonomy ratio taken into consideration. The risk indexes were calculated by comparing the bankruptcy frequency of each interval to the bankruptcy frequency specific to the entire population (average bankruptcy frequency = 2.85% for 2010). The risk indexes presented in table 3 suggest a tendency of reduction of the bankruptcy risk with the increase of the autonomy ratio (although the tendency is not perfectly monotone).

A reduction of the number of intervals and a confirmation of the risk relative level associated to each interval (for other years) could offer the analyst a useful instrument for classifying the companies on risk classes.

Based on the dynamics of the risk indexes (table 4), 3 intervals of reference are suggested in the use of the autonomy ratio:

- (-∞;10%) – high level of bankruptcy risk;
- [10%;50%) – medium level of bankruptcy risk;
- [50%;100%] – low level of bankruptcy risk.

Table 4. Risk indexes for the target population, on intervals of the autonomy ratio

No.	Autonomy ratio	2007	2008	2009	2010
1	Autonomy ratio < -20%	96%	135%	149%	147%
2	-20% <= Autonomy ratio < -10%	390%	93%	210%	151%
3	-10%<= Autonomy ratio < 0%	194%	79%	118%	144%
4	0%<= Autonomy ratio < 10%	136%	186%	202%	163%
5	10%<= Autonomy ratio < 20%	152%	77%	62%	73%
6	20%<= Autonomy ratio < 30%	0%	142%	107%	61%

7	30% <= Autonomy ratio < 40%	102%	107%	62%	93%
8	40% <= Autonomy ratio < 50%	60%	78%	26%	70%
9	50% <= Autonomy ratio < 60%	0%	21%	39%	31%
10	Autonomy ratio >= 60%	46%	43%	16%	21%

In defining the intervals, a greater importance has been awarded to 2010, which was considered to be more representative for the following years (table 5).

Table 5. Risk classes in accordance with the values of the autonomy ratio (2010)

No.	Autonomy ratio – target population 2010	Total		% Bankruptcy	Risk index
		15,071	100%	2.85%	
1	Autonomy ratio < 10%	7,843	52.0%	4.26%	149.6%
2	10% <= Autonomy ratio < 50%	3,278	21.8%	2.10%	73.9%
3	Autonomy ratio >= 50%	3,950	26.2%	0.66%	23.1%

It is underlined that the inclusion of companies with autonomy ratios lower than 10% in the "high bankruptcy risk" class does not automatically associates those companies with a probability of bankruptcy of over 0.5. In reality, 95.74% of the companies included in the "high bankruptcy risk" class from the target population of 2010 will not go bankrupt in 2012. The risk level that characterizes this class of companies is higher than the average: 4.26% of the companies included in this class would go bankrupt in 2012, while the frequency of bankruptcy over the entire target population was of only 2.85%.

Using the proposed methodology, a creditor may decide to grant priority to the companies in the "low bankruptcy risk" class and to take more precautions in the relationship with the companies from the "medium bankruptcy risk" and "high bankruptcy risk" classes.

The information given to the analyst by the proposed methodology is that:

- of 1,000 companies included in the "low bankruptcy risk" class, 7 will become bankrupt within 2 years;
- of 1,000 companies included in the "medium bankruptcy risk" class, 21 will become bankrupt within 2 years;
- of 1,000 companies included in the "high bankruptcy risk" class, 43 will become bankrupt within 2 years.

Considering the results of previous studies in regards to the correlation between the autonomy ratio and the return on equity (Brindescu-Olariu, 2014), the optimum value of the autonomy ratio is placed within the interval [50%;100%]. This conclusion is based on the following aspects:

- the interval [50%;100%] shows the lowest level of bankruptcy risk;
- the interval [50%;100%] shows the lowest level of financial risk (Brindescu-Olariu, 2014a);
- the interval [50%;100%] has the highest frequency of companies with returns on equity within the interval [0%;50%] (Brîndescu-Olariu, 2014a).

4. Conclusions

The studies undertaken over the companies from Timis County, Romania, demonstrate the utility of the autonomy ratio in the prediction of bankruptcy.

The use of 3 reference intervals for the autonomy ratio is recommended:

- (-∞;10%) – high level of bankruptcy risk;
- [10%;50%) – medium level of bankruptcy risk;
- [50%;100%] – low level of bankruptcy risk.

Considering the bankruptcy risk, the financial risk and the potential of return on equity, the optimum value of the autonomy ratio is concluded to be placed within the interval [50%; 100%]. It is expected for the frequency of the bankruptcy cases to change in time, which makes it necessary for the probabilities to be continuously updated. The analysis will not be able to indicate with absolute certainty to the analyst whether a specific company would go bankrupt or it would continue its activity under normal conditions. In fact, the analyst will be right to assume that, most probably, the company under analysis will not go bankrupt (based on the fact that the bankruptcy probability for each of the 3 intervals of reference is significantly lower than 0.5). Still, classifying the companies on risk classes will create the basis for the application of different treatments for different risk classes.

In accordance with its own policy, a bank could decide not to grant a loan to a company from the "high bankruptcy risk" class, to impose limitations to the investment policy of the company, to set higher interest rates and fees, to ask for more solid mortgages, increases of the share capital or the retaining of profits as equity until the autonomy ratio would increase enough for the company to make the transition to a better risk class.

The current research should be continued with studies on the following directions:

- the correlation between the dynamics of the autonomy ratio and the bankruptcy probability ;
- the correlation between the bankruptcy risk and the absolute and relative variation of the autonomy ratio in relation to the average value of the sector;
- the correlation between the autonomy ratio and the potential in terms of return on equity;
- the correlation between the autonomy ratio and the financial risk;
- the applicability of the proposed methodology for companies of other regions.

The proposed methodology should be updated annually, to ensure a permanent adaptation to any modifications of the characteristics of the target population.

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